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Quantitative Analysis of Major and Trace Elements in NH$_4$HF$_2$-modified Geological Sample Powders by Laser Ablation - Inductively Coupled Plasma Mass Spectrometry

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ABSTRACT: We described a NH$_4$HF$_2$ digestion method as sample preparation for the rapid determination of major and trace elements in silicate rocks using laser ablation-inductively coupled plasma mass spectrometry (LA-ICP-MS). Sample powders digested by NH4HF2 at 230 °C for 3 hours form ultrafine powders with a typical grain size d$_{80}$ < 8.5 μm, and various silicate rocks have a consistent grain morphology and size, allowing us to produce pressed powder pellets that have excellent cohesion and homogeneity suitable for laser ablation micro-analysis without the addition of binder. The optimized NH$_4$HF$_2$ digestion method was applied to dissolve six silicate rock reference materials (BCR-2, BHVO-2, AGV-2, RGM-2, GSP-2, GSR-1) covering a wide range of rock types. Ten major elements and thirty-five trace elements were simultaneously analysed by LA-ICP-MS. The analytical results of the six reference materials generally agreed with the recommended values, with discrepancies of less than 10 % for most elements. The analytical precision is within 5 % for major elements and within 10 % for most trace elements. Compared with previous methods of LA-ICP-MS bulk analysis, our method enables the complete dissolution of refractory minerals, such as zircon, in intermediate-acidic intrusive rocks and limits contamination as well as the loss of volatile elements. Therefore, the NH$_4$HF$_2$ digestion method can be used as a new alternative in LA-ICP-MS for bulk analysis of geological samples.

KEY WORDS: Whole-rock geochemical analysis, NH$_4$HF$_2$ digestion, LA-ICP-MS